Notice of Allowability	Application No. 10/080,488	Applicant(s) BUTTERWORTH ET AL.	
	Examiner Reginald G. Bragdon	Art Unit 2188	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the amendment filed 19 July 2004 and the brief filed 08 November 2004*.

2. ☒ The allowed claim(s) is/are *1-6, 8, 7, and 9-22, renumbered 1-22*.

3. ☒ The drawings filed on *22 February 2002* are accepted by the Examiner.

4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☒ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

2. This amendment is presented in order to enter the amendment filed by Applicant on 19 July 2004. No changes have been made to content of the amendment to the specification and claims as presented by the Applicant. However, the amendment of 19 July 2004 was not in the proper format in accordance with 37 CFR 1.121(h) in that the amendment to the specification was not on a separate page from the amendment to the claims. In order to enter the amendment of 19 July 2004, the Examiner is presenting this Examiner's amendment incorporating the amendment of 19 July 2004.

3. The application has been amended as follows:

IN THE SPECIFICATION

Please amend the paragraphs as follows.

On page 19, beginning on line 1.

Destage operations are much simpler since these always occur as full stripe writes. In this case the data and parity are written as the position shown in Fig. ~~34~~ and the bitmap is updated if necessary to show that the data and parity have been removed.

IN THE CLAIMS

1. (Currently Amended) A method of adding an information storage device to a plurality of information storage devices in an information processing system in which a processor is connected for communication with the information storage devices by means of a log structured array (LSA) controller in which ~~the~~ information is stored as a plurality of stripes extending across the plurality of storage devices ~~of the array~~, the LSA controller further defining a directory which specifies storage locations using ~~relative addresses~~ a construct comprising a stripe number and an offset, the method comprising connecting the additional information storage device to the LSA controller and logically appending an additional strip provided to each existing stripe by the additional storage device to the end of each stripe in the directory.

2. (Original) The method of claim 1, further comprising configuring the plurality of information storage devices as an N+1 array.

3. (Original) The method of claim 1, wherein each stripe comprises N information strips and one parity strip, each information strip storing an integer number of logical tracks.

4. (Previously Amended) The method of claim 1, wherein the directory comprises a LSA directory which specifies the location of a logical track in terms of the ID of the stripe to which the track belongs and the offset of the track within the stripe.

5. (Previously Amended) The method of claim 1, wherein prior to the addition of the

additional storage device, the parity strips are rotated amongst the N+1 information storage devices in accordance with a RAID-5 architecture, the method further comprising moving selected parity strips to the additional information storage device at locations that would have stored parity strips had the array originally comprised N+2 information storage devices.

6. (Original) The method of claim 5, wherein the data and parity strips are moved to the additional storage device during normal IO operations to the devices.

7. (Original) The method of claim 5, wherein a background task is defined by the controller to move the data and parity strips to the additional storage device.

8. (Previously Amended) The method of claim 6, wherein a bitmap is defined by the controller, each bit of the bitmap representing an array stripe and indicating whether the data and parity strips of the stripe are located in their original position or in the position appropriate to the plurality of information storage devices including the additional information storage device .

9. (Original) The method of claim 1, wherein the additional information storage device is initialised to all binary zeros prior to connection to the controller.

10. (Original) The method of claim 1, further comprising connecting a plurality of additional information storage devices to the log-structured array controller and logically appending the additional strips, provided to each existing stripe by the additional storage devices, to the end of each stripe in the LSA directory.

11. (Currently Amended) The method of claim 1, wherein connecting the additional information storage device to the LSA controller further comprises:

initializing the new disk to all binary zeroes so that the new disk can be included in the parity calculations without modifying the parity already on disk;

temporarily suspending accesses to a RAID 5 array controlled by the LSA controller and flushing any data cached by the RAID array ~~prior to temporarily suspending access~~;

adding the new disk as a member of the RAID array; and

applying an algorithm to optionally relocate the parity and/or the data.

12. (Currently Amended) A log structured array (LSA) controller comprising a logic device configured to control the transfer of information between a processor and a plurality of information storage devices in which the information is stored as a plurality of stripes extending across the plurality of storage devices ~~of the array~~, and further configured upon the addition of a new information storage device to the array, to logically append to the end of each stripe in a directory a new strip provided for the new information storage device, the directory specifying storage locations using ~~relative addresses~~ a construct comprising a stripe number and an offset.

13. (Original) The LSA controller of Claim 12, wherein the plurality of information storage devices are configured as an N+1 array.

14. (Original) The LSA controller of Claim 12, wherein each stripe comprises N information strips and one parity strip, each information strip storing an integer number of logical tracks.

15. (Previously Amended) The LSA controller of Claim 12, wherein the directory further comprises an LSA directory specifying the location of a logical track in terms of the ID of the stripe to which the track belongs and the offset of the track within the stripe.

16. (Currently Amended) A log structured array (LSA) controller for adding an information storage device to a plurality of information storage devices in an information processing system in which a processor is connected for communication with the information storage devices by means of a log structured array (LSA) controller in which the information is stored as a plurality of stripes extending across the plurality of storage devices ~~of the array~~, the LSA controller comprising:

a directory which specifies storage locations using ~~relative addresses~~ a construct comprising a stripe number and an offset;

means for connecting the additional information storage device to the LSA controller; and means for logically appending an additional strip provided to each existing stripe by the additional storage device to the end of each stripe in the directory.

17. (Previously Amended) The log structured array (LSA) controller of claim 16, further comprising means for configuring the plurality of information storage devices as an N+1 array.

18. (Previously Amended) The log structured array (LSA) controller of claim 16, wherein each stripe comprises N information strips and one parity strip, each information strip storing an integer number of logical tracks.

19. (Previously Amended) The log structured array (LSA) controller of claim 16, wherein the directory comprises a LSA directory which specifies the location of a logical track in terms of the ID of the stripe to which the track belongs and the offset of the track within the stripe.

20. (Currently Amended) An information storage system comprising:

a plurality of information storage devices;

a processor connected for communication with the information storage devices by means of a log structured array (LSA) controller in which the information is stored as a plurality of stripes extending across the plurality of storage devices ~~of the array~~,

an LSA controller comprising a directory which specifies storage locations using ~~relative addresses~~ a construct comprising a stripe number and an offset, the LSA controller configured to connect an additional information storage device to the LSA controller and logically append an additional strip provided to each existing stripe by the additional storage device to the end of each stripe in the directory.

21. (Original) The information storage system of claim 20, wherein the plurality of information storage devices comprise an N+1 array.

22. (Original) The information storage system of claim 20, wherein each stripe comprises N information strips and one parity strip, each information strip storing an integer number of logical tracks.

4. The following is an examiner's statement of reasons for allowance:

While the references separately teach adding an additional storage device to an array (Schultz et al. or Choy et al.) and an LSA directory storing a strip and offset (Brady et al.), the combination of references does not teach, suggest or provide motivation for "logically appending an additional strip provided to each existing stripe by the additional storage device to the end of each stripe in the directory" when connecting or adding an additional information storage device to an LSA controller, in combination with the other elements of the independent claims.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Reginald G. Bragdon whose telephone number is (571) 272-4204. The examiner can normally be reached on Monday-Thursday from 7:00 AM to 4:30 PM and every other Friday from 7:00 AM to 3:30 PM.

The examiner's supervisor, Mano Padmanabhan, can be reached at (571) 272-4210.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

Reginald G. Bragdon
Reginald G. Bragdon
Primary Patent Examiner
Art Unit 2188

RGB
April 21, 2005